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Original Article

Safety and efficacy of epicardial approach to catheter ablation of ventricular tachycardia – An institutional experience

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ABSTRACT

Background and aim: Epicardial approach to VT ablation increases the success rate of ablation but is not without complications. We studied the safety and efficacy of epicardial VT ablations performed at our institute.

Methods: All patients who underwent epicardial VT ablation at our institute were studied retrospectively. The outcome of VT ablation was among three groups: ischaemic cardiomyopathy (ICM), non-ischaemic cardiomyopathy (NICM) and granulomatous myocarditis (GM). Safety outcomes assessed included all complications considered to be due to pericardial access or epicardial mapping/ablation.

Results: A total of 54 patients (total 119 VTs, mean 2.2 (0.9)) were taken up for ablation procedure through epicardial access. Mean age: 47 (10) years, males: 83%. All patients had drug resistant recurrent VTs. The epicardial procedure was abandoned in three patients due to access issues; percutaneous sub-xiphoid access was employed in 48 and surgical approach in four patients. Complete success was achieved in 59% and partial success in 76%. The outcomes were poor in ICM patients as compared to those with GM and NICM. Overall success rates for all clinical VTs were 89% in GM, 90% in NICM and 67% in ICM. Success rates for epicardial VT ablation were 94%, 85% and 78% respectively for GM, NICM and ICM. Procedure related complications occurred in six patients.

Conclusion: Epicardial ablation for VT offers good immediate outcomes with acceptable safety profile.

1. Introduction

Ablation of ventricular tachycardia (VT) is associated with variable success rates. Despite advancements in technology and improved understanding of arrhythmia mechanisms, acute and long-term success rates of endocardial ablation remains modest.[1–3] An important reason cited for the failure is the presence of the re-entry circuits deep within the endocardium or on the epicardium.

Epicardial location of VT is observed in about 70% of patients with Chaga's disease.[4] Presence of epicardial substrates, its density and distribution is increasingly being recognized in other forms of scar-related cardiomyopathies[4–13] too. In patients undergoing endocardial ablation of VT, about 15–30% of failures are being attributed to the epicardial location of re-entry circuits.[14] Failure rates vary with different etiologies ranging from 50 to 80%.[6,11,12,15–17] With high prevalence of epicardial location of re-entry circuits and high rate of recurrence of VT after endocardial ablations, the epicardial approach in tackling these conditions is increasingly being recognized.

Epicardial approach to VT ablation is being performed routinely in some institutions with variations in patient selection, approach and strategies related to mapping and ablation.[5,7,8,10,18,19] We studied the acute safety and efficacy of epicardial VT ablations done at our Institute.

2. Materials and methods

This is a retrospective study of all patients who underwent epicardial access for ablation of VT at our Institution from August 2008 till November 2015. It includes both first line (direct epicardial) and second-line approach. In the second line approach, mapping was performed initially using the endocardial approach. Based on the mapping information we decided to access the

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epicardium. Direct epicardial approach was performed when ECG recording during an episode of VT revealed features of epicardial origin or scar confined to the epicardium was observed on cardiac magnetic resonance (CMR) imaging. Procedure was performed after obtaining informed consent from all patients. Beta-blockers were stopped five half-lives and amiodarone three weeks before an elective procedure. Mexiletine was stopped three days prior to the procedure.

All procedures were performed under local anaesthesia and conscious sedation.[20] General anaesthesia was mainly reserved for patients who underwent surgical access to the pericardium. Sedation was initiated with intravenous bolus of midazolam hydrochloride (1 mg). The doses were repeated depending on the level of consciousness of the patients. In addition, intravenous fentanyl citrate 20 mcg was used followed by 2–3 mcg/min of infusion for short-term analgesia.

2.1. Mapping, induction and ablation procedure

All procedures were done under intravenous anticoagulation using intravenous heparin with initial bolus of 50–100 IU/kg followed by a 1000 IU/h perfusion. The maintenance dose was titrated to maintain the activated clotting time above 250/300 s.

Vascular access was obtained via right femoral vein and artery. Quadripolar catheters were positioned in the region of His bundle, right ventricle and right atrium through femoral venous access. Mapping and ablation was performed with 3.5 mm open irrigated tip ThermoCool, Navistar, catheter (Biosense Webster, Diamond Bar, California). Three dimensional electroanatomic mapping was done with CARTO (Biosense Webster, Diamond Bar, CA) or NavX system (St Jude Medical, Minneapolis, MN).

Ventricular tachycardia induction was performed with programmed electrical stimulation (PES) with up to two basic drive cycle length (CL) of 600 and 400 milliseconds (ms) and 1–3 extra stimuli from right ventricular apex and outflow tract. If VT was not induced at baseline, isoprenaline was infused for facilitation.

Unstable VTs were mapped during sinus rhythm and substrate mapping. Channels and entry and exit sites were further defined by pace mapping. Bipolar pace-mapping was performed at 10 mA and a pulse width 2 ms. During activation mapping, mid-diastolic or pre-systolic potentials were sought, entrainment was performed and critical isthmus of the VT re-entrant circuit defined. Radiofrequency (RF) energy was delivered at sites where there was concealed entrainment with stimulus to QRS (S-QRS) nearly equal to electrogram to QRS duration and post pacing interval nearly identical to tachycardia cycle length (TCL). If the tachycardia could not be entrained, the earliest local ventricular electrograms were targeted. During substrate mapping, areas of low voltage, isolated late potentials and fractionated potentials were tagged. Following this, stimuli were given to the tagged area and S-QRS duration was measured to identify the critical isthmus.

During the procedure, where suggestion of epicardial substrates surfaced, anticoagulation was reversed with intravenous protamine sulphate and epicardial access was attempted.

2.2. Pericardial access

Percutaneous epicardial access was obtained through the sub-xiphoid approach using an epidural needle as described previously. In patients where the percutaneous access failed, the surgical approach to create a sub-xiphoid window or limited lateral thoracotomy under general anaesthesia was performed the following day. The site of surgical access was chosen according to the area of interest in the epicardium.

2.3. Safety measures during epicardial ablation

A coronary angiogram was performed after mapping if ablation was planned on the left ventricular epicardial wall to ensure the absence of coronary artery at the site of target. Ablation was avoided at sites close to a major coronary artery. Injury to the left phrenic nerve was avoided using the technique as described by Fan et al.[21] In short, a high output pacing (>10 mA) along the left lateral wall was given to assess phrenic nerve capture during energy delivery. In case of phrenic nerve capture, manoeuvres to separate the epicardium from the parietal pericardium were attempted. The ablation of the target site was avoided if the manoeuvres failed.

After performing ablations for targeted VTs, programmed stimulation was repeated as pre-ablation. Re-ablations were attempted for any inducible VTs. In case of repeated inducibility, the procedure was terminated after 2–3 attempts of ablation. Post procedure, beta blockers were continued for life and amiodarone was given on low dose following which it was tapered and stopped if there was no VT recurrence.

2.4. Acute procedural outcomes: definition of terms

Complete success: The total elimination of all inducible VT at the end of the procedure.

Partial success: The elimination of all inducible clinical VTs but the persistence of non-clinical VT (s).

Failure: The inability to render clinical VT non inducible at the end of the procedure.

2.5. Procedural complications

Any complication that happened during hospital stay and deemed to be due to pericardial access or ablation procedure were considered procedural complications.

2.6. Post-procedural patient care

Following the procedure, excess fluid within the pericardium was drained and a pig tail catheter was left within the pericardium after administering intra-pericardial methylprednisolone. A trans-thoracic echocardiogram was performed three hours and 24 h following the procedure. The pericardial drain was removed after 24 h if the collection was ≤50 ml. The clinical course of all patients until discharge was traced and recorded.

2.7. Statistical analysis

Continuous variables are represented as mean and standard deviation where data follows normal distribution, otherwise as median with range. Data was analyzed using STATA 13.

3. Results

Between August 2008 till December 2015, a total of 54 patients (total 119 VTs, mean 2.2 (0.9)) were taken up for ablation procedure through epicardial access. The mean age was 47 (10) years with 45 (83%) males. Table 1 gives baseline demographics and clinical profile of all patients.

3.1. Indications for radiofrequency ablation

Twenty-eight patients (52%) had implantable cardioverter defibrillator (ICD). Recurrent, appropriate shocks were the indication of RFA in all these patients. Eighteen patients had either VT storm or incessant VT and the remaining eight patients had recurrent haemodynamically unstable VT.